Relative abundance of rough fish in the river channel

Expectation: A statistically significant decrease in relative abundance of rough fish within the river channel.

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Relevant Endpoint(s): Restoration - Biological Integrity - Community Structure
Restoration - System Functional Integrity - Habitat Quality

Baseline Conditions: Channelization of the Kissimmee River altered hydrologic, geomorphologic, and dissolved oxygen characteristics of the river. These alterations and associated ecological changes have favored an increase in relative abundance of rough fish species within the channelized system.

Dissolved oxygen regimes persist at the tolerance threshold (2.0 ppm) for many fish species (Moss & Scott 1961, Davis 1975, Smale and Rabeni 1995, Matthews 1998) and periodically reach critically low levels (<0.5 ppm) during summer months (Toth 1993, Koebel 1995), allowing tolerant species (i.e., *Lepisosteus platyrhincus* – Florida gar and *Amia calva* - bowfin) to displace less tolerant species (i.e., *Micropterus salmoides* - largemouth bass and *Pomoxis nigromaculatus* - black crappie) (Matthews 1998). Increased coverage of in-channel vegetation also has favored *A. calva* and *L. platyrhincus*, which prefer densely vegetated, lentic habitats (Lee et al. 1980).

Post-channelization river channel fish communities were sampled in June 1997 and May 1998 using block nets and fish toxicant (5% emulsified rotenone). Block nets enclosing 0.2 ha were deployed in three remnant river runs within Pool A (Ice Cream Slough Run, Rattlesnake Hammock Run, and Persimmon Mound Run) and Pool C (MacArthur Run, Micco Bluff Run, and Oxbow 13 Run). The sampled community within Pools A and C was comprised of 19 large-bodied species (Table 1). Four sampled rough fish species (*A. calva, Dorosoma cepedianum* – gizzard shad, *Lepisosteus osseus* – longnose gar, *L. platyrhincus*) were not collected during historic river channel sampling. Pool A samples were composed of 16 species and dominated by gamefish, which accounted for an annual average of 69% of total fish abundance. Rough fish accounted for an annual average of 24% of fishes sampled, while catfish (6%) and exotics (1%) made up the balance of fish sampled. The rough fish community was dominated by *L. platyrhincus* (*L. platyrhincus* 60.7%, *Erimyzon sucetta*: lake chubsucker 15.3%, *A. calva* 23.6%, *L. osseus*: longnose gar 0.4%).

Pool C samples had 16 species and also were dominated by gamefish (annual mean = 75.4%). Rough fish comprised an annual average of 13.8% of fish sampled, while catfish (9.3%) and exotics (1.5%) accounted for the balance. The rough fish community within Pool C also was dominated by *L. platyrhincus* (*L. platyrhincus* 55.1%, *E. sucetta* 24.6%, *A. calva* 18.8%, *D. cepedianum* 1.5%).

Milleson (1976) utilized block nets and fish toxicant to sample 0.20 ha of remnant river in Pool B. Collected fishes included 11 species and were dominated by gamefish, which represented 96% of total sample abundance. The rough fish community comprised 3.2% of the sample and was dominated by *D. cepedianum* (66%), *L. platyrhincus* (22%), and *E. sucetta* (11%).

Annual electrofishing by the Florida Game and Freshwater Fish Commission (FGFWFC) within remnant river channels and C-38 canal in Pools A and C in June 1992-1994 (FGFWFC 1996) yielded 15 large-bodied species (Table 2). In Pool A, rough fish comprised 56.5% of the river channel community, and 30.8% of the canal community. Gamefish dominated the canal community (68.9%), but made up only 43% of the river channel community. Gamefish were dominant in both areas in Pool C (canal 63.2%, river channel 54.5%). Rough fish comprised 35.3% and 42.1% of the canal and river channel fish communities, respectively. *Lepisosteus platyrhincus* dominated rough fish communities in the canal and river channel in both pools (Pool A: canal 86.4%, river channel 76.8%; Pool C: canal 74%, river channel 69.8%).

Reference Conditions:

Historical data on fish community structure of the Kissimmee River (channel) are limited to a single study (FGFWFC 1957), in which river channel fish were sampled using block nets and 5% emulsified rotenone. Sampling was conducted within a lower reach of the Kissimmee River during drought conditions, where one acre (0.4 ha) of historic river channel contained 8 species (Table 1). Community composition was dominated by catfish (85.9%), followed by gamefish (12.3%) and rough fish (1.7%). Rough fish were represented by a single species (*E. sucetta*). No exotic species were collected.

Bass (1991) summarized electrofishing data collected by FGFWFC from 12 Florida rivers from 1983-1987. Three of these rivers (Peace, Withlacoochee, and Oklawaha) are located entirely within or have headwaters originating in peninsular Florida below the Suwannee drainage, the demarcation between peninsular and northern fish assemblages (Gilbert 1987). All three rivers have undergone varying degrees of anthropogenic alteration that include channelization, impoundment, and point and industrial sources of pollution (Bass 1991, Estevez et al. 1991, Livingston 1991, Livingston and Fernald 1991) and therefore are not pristine reference sites for the historic Kissimmee. However, data from these rivers provide information on the composition of riverine fish communities within peninsular Florida. Centrarchids comprised at least 56.4% of the most abundant species (small and large-bodied) within main channel habitats of all peninsular rivers except the Peace River (22.3%)(Table 3). Community composition of rough fish species was greatest within the Peace River (12.4%) and did not exceed 4.3% in the other rivers.

Mechanism relating restoration:

Re-establishment of a fish community resembling that of the historic system requires restored riverine habitats that match the habitat requirements of the historic community (Sheldon & Meffe 1995). Re-establishment of historic hydrologic characteristics will be the mechanism driving the restoration of river channel habitat and associated changes in the rough fish community. Restoration of continuous discharge through the river channel will increase dissolved oxygen levels by turbulent mixing and flushing of accumulated organic deposits and their associated biological oxygen demand (Toth 1993, 1996). Dissolved oxygen profiles are expected to be less stratified (especially during summer months), with higher dissolved oxygen levels found throughout the water column. Increased dissolved oxygen levels will allow less tolerant species to better compete with tolerant rough fish species that currently dominate the system (Matthews 1998).

Both *L. platyrhincus* and *A. calva* prefer heavily vegetated habitats with limited flow velocities (Lee et al. 1980). Seasonal high discharges will limit areal coverage of littoral vegetation along the river channel (Williams & Wolman 1984, Ligon et al. 1995). Increased flow velocities and decreased vegetative cover will likely lead to the lateral migration of these species onto floodplain habitats (Welcomme 1979) thereby decreasing their abundance within the restored river channel.

The abundance of *D. cepedianum* is expected to decrease with the re-establishment of flow. *D. cepedianum* is an open water species that thrives in warm, sluggish, shallow bodies of water with soft mud bottoms, high turbidity, and relatively few predators (Williamson & Nelson 1985). Post-restoration conditions will provide continuous flow and re-establish sand substrate, thereby creating habitats that are not conducive for this species.

Adjustments for External Constraints: None

Time Course: Decreased relative abundance of rough fish is dependent on changes in hydrology, geomorphology, and associated biological, physical, and chemical attributes and is expected to occur within 3-5 years following re-establishment of continuous instream flows. Restoration time frames may require adjustment if appropriate hydrologic and geomorphologic characteristics are not met.

Means of Evaluation: Block net and electrofish sampling will be conducted following 2 years of continuous flows through study sites in Pool C. Methods will be identical to those utilized for baseline studies. Two blocknet sampling events will occur during two years of minimal flow within 10 years of reintroduction of continuous flows. Electrofish sampling (Wallop-Breaux F-52 Completion Report 1991) will be conducted annually, for three year periods, beginning on the 3rd, and 8th year following introduction of continuous flows.

Samples will be analyzed for species composition and richness, relative abundance of functional groups, and relative abundance of size classes of functional groups. Differences in relative abundance will be considered significant if statistical tests result in $P \leq 0.05$. Baseline values used for comparisons of relative abundance of rough fish species for block net and electrofish sampling are 13.8% (±1.2) and 42.1% (±2.0), respectively.

Table 1. Mean annual (± SE) relative abundance (percentage of total numbers) of large-bodied fish species sampled within block nets in the Kissimmee River.

		Reference	Baseline		
Species	Common Name	GFC 1957	Milleson '76	Pool A '97-98	Pool C '97-98
GAME FISH:					
Lepomis gulosus	warmouth	0.8	15.7	20.1 ± 0.6	33.4 ± 8.5
Lepomis macrochirus	bluegill	7.3	52.6	28.7 ± 2.3	30.6 ± 6.8
Lepomis microlophus	redear sunfish	2.5	14.9	4.9 ± 0.2	2.7 ± 0.7
Lepomis punctatus	spotted sunfish	--	2.2	1.3 ± 0.7	2.1 ± 1.1
Micropterus salmoides	largemouth bass	1.7	5.8	4.4 ± 3.8	3.3 ± 2.7
Pomoxis nigromaculatus	black crappie	--	4.6	9.2 ± 5.4	3.2 ± 1.1
Esox nigromaculatus	chain pickerel	--	--	0.2 ± 0.2	--
Esox niger	redfin pickerel	--	--	--	0.1 ± 0.1
ROUGH FISH:					
Amia calva	bowfin	--	--	5.7 ± 1.1	2.6 ± 1.5
Erimyzon sucetta	lake chubsucker	1.7	0.3	3.7 ± 3.0	3.4 ± 1.5
Dorosoma cepedianum	gizzard shad	--	2.2	--	0.2 ± 0.2
Lepisosteus osseus	longnose gar	--	--	0.1 ± 0.1	--
Lepisosteus platyrhincus	Florida gar	--	0.7	14.7 ± 6.9	7.6 ± 1.6
CATFISH:					
Ameiurus catus	white catfish	0.8	--	--	--
Ameiurus natalis	yellow bullhead	--	--	0.1 ± 0.1	--
Ameiurus nubulosus	brown bullhead	0.8	0.3	5.9 ± 5.0	9.2 ± 6.4
Ictalurus punctatus	channel catfish	84.4	0.7	--	0.1 ± 0.1
EXOTIC FISH:					
Hoplosternum littorale	armored catfish	--	--	0.6 ± 0.6	0.1 ± 0.1
Oreochromis aureus	blue tilapia	--	--	0.1 ± 0.1	0.2 ± 0.2
Clarias batrachus	walking catfish	--	--	0.3 ± 0.3	1.2 ± 1.2

Table 2. Mean annual (± SE) relative abundance (percentage of total numbers collected over sample period) of large-bodied fish species collected within remnant river runs of Pools A and C by FGFWFC during electrofishing conducted between 1992-1994.

Species	Common Name	Pool A	Pool C
GAME FISH:			
Esox niger	chain pickerel	0.7 ± 0.5	0.4 ± 0.1
Lepomis gulosus	warmouth	1.7 ± 0.5	6.7 ± 2.0
Lepomis macrochirus	bluegill	25.5 ± 4.0	23.9 ± 3.1
Lepomis microlophus	redear sunfish	2.9 ± 0.7	6.2 ± 0.3
Lepomis punctatus	spotted sunfish	0.1 ± 0.1	1.9 ± 0.8
Micropterus salmoides	largemouth bass	11.3 ± 5.3	13.7 ± 1.6
Pomoxis nigromaculatus	black crappie	0.8 ± 0.5	1.7 ± 0.3
ROUGH FISH:			
Amia calva	bowfin	10.7 ± 3.5	7.2 ± 1.9
Erimyzon sucetta	lake chubsucker	2.0 ± 0.5	5.1 ± 1.4

Dorosoma cepedianum	gizzard shad	0.4 ± 0.4	--
Lepisosteus osseus	longnose gar	--	0.4 ± 0.2
Lepisosteus platyrhincus	Florida gar	43.4 ± 3.3	29.4 ± 4.3
CATFISH:			
Ameiurus natalis	yellow bullhead	--	0.7 ± 0.3
Ameiurus nubulosus	brown bullhead	0.2 ± 0.2	0.5 ± 0.2
EXOTIC FISH:			
Oreochromis aureus	blue tilapia	--	--
Clarias batrachus	walking catfish	0.3 ± 0.3	2.2 ± 0.7

Table 3: Relative contribution (% of numerically dominant species) of large-bodied fish species in the Withlacoochee (WIT), Oklawaha (OKL), and Peace Rivers (PEA) (modified from Bass 1991).

Species	Common Name	WIT	OKL	PEA
GAMEFISH:				
Lepomis auritus	redbreast sunfish	21.1	24.1	--
Lepomis gulosus	warmouth	5.9	5.6	--
Lepomis macrochirus	bluegill	14.6	24.9	10.3
Lepomis microlophus	redear sunfish	6.0	9.3	5.9
Lepomis punctatus	spotted sunfish	19.0	12	--
Micropterus salmoides	largemouth bass	3.9	4.6	6.1
ROUGH FISH:				
Amia calva	bowfin	1.8	0.9	--
Dorosoma cepedianum	gizzard shad	--	0.9	--
Lepisosteus osseus	longnose gar	--	1.1	--
Lepisosteus platyrhincus	Florida gar	2.5	1.1	12.4
CATFISH:				
Ictalurus punctatus	channel catfish	--	--	4.6
	Total	54.7	61.7	54.0

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